CRYSTAL-FACE weather support & its role in flight planning

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1. Forecasting and flight planning challenges in CRYSTAL-FACE
2. A proposed approach to flight planning and coordination
3. Outside support and FAA interaction
4. South Florida WX predictability
5. Science team guidance and forecast products
6. Action items

Forecasting and flight planning challenges in CRYSTAL-FACE

- Convective and anvil phenomenology VERY difficult to forecast, although convective environment reasonably predictable
- Need for one or more flight plan adjustments once aircraft are airborne

- South Florida is an active air traffic zone (below FL290) with little room for maneuver on heavy weather days
- A halfDOZEN aircraft with wide range of air speeds, yet tight coordination a necessity for some scientific goals

An approach to flight planning

1. Pre-arranged, yet maximally flexible, coordinated flight plans: Keep them simple!
2. Weather guidance generated by science team in consultation with local professional forecasters
3. In-flight adjustment of flight plans by Flight Scientist working from NPOL radar at Ground Site West
4. Timely notification of Missions Group at Miami ARTCC

- and …take advantage of predictable elements of south Florida meteorology

Proposed organization for flight planning and in-flight coordination

1. **Key West flight planning group:** Mission scientists, Mission Manager, aircraft scientist and representative from ground site team
2. **Weather support team:** Mission Meteorologist (R. Selkirk) plus rotating teams of 3-4 support scientists each
3. **Ground site flight coordination team:** Flight scientist (Dave Starr), NPOL radar group (John Gerlach), Aircraft Communications Specialist (J. V. Nystrom) in consultation with ground site scientists
4. **FAA Missions Group - Miami ARTCC** (Hank Tracy et al.)
5. **Outside met support resources: USN, NWS forecasters**

Outside WX guidance

- **USN Key West Weather Detachment (NLMOD):** Flight day briefings
- **NWS Miami WFO:** Scheduled phone consultation with Lead Forecaster (assisted by U. of Miami grad student under direction of B. Albrecht)
- **NWS Key West WFO:** Guidance over Florida Bay and Keys; possible access to their office and AWIPS console post-takeoff

ATC Interaction

- Work with **Miami ARTCC Mission Group** to facilitate air controller staffing and flight change requests on flight days
- **USN Key West TARPON Military Radar Unit (MRU)** has jurisdiction over offshore Warning areas

FAA Interaction

- **USN Key West weather detachment (NLMOD):** Flight day briefings
- **NWS Miami WFO:** Scheduled phone consultation with Lead Forecaster (assisted by U. of Miami grad student under direction of B. Albrecht)
- **NWS Key West WFO:** Guidance over Florida Bay and Keys; possible access to their office and AWIPS console post-takeoff

Possible flight planning decision flow

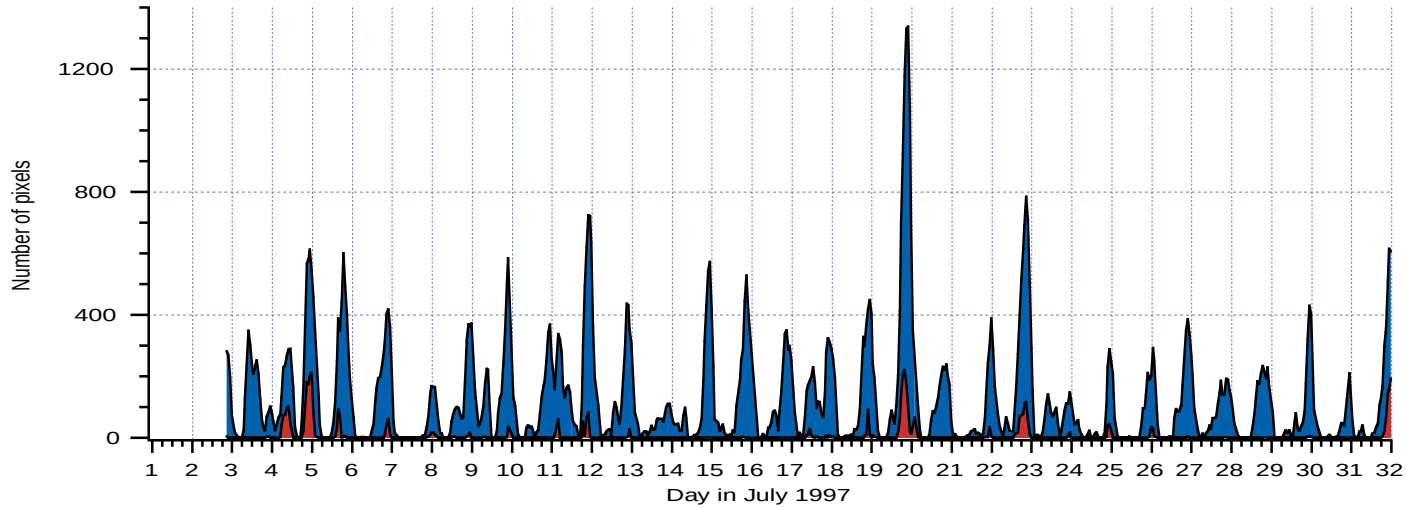
(nominal timings)

	DECISION	TIME FRAME
1	**CHOOSE predefined profile set**	18 UT = 14 LT (Day -1)
	SET morning load time	
	ASSEMBLE latest weather guidance	13:30 UT = 9:30 LT
	BRIEF flight planning group	
	NOTIFY FAA Missions Group of predefined flight plan	14 UT = 10 LT
2	**REFINE predefined flight profile set**	15 UT = 10 LT
	FILE flight plans	15 UT = 10 LT
	TAKEOFF (e.g. P-3 earlier, WB-57 later)	~18 UT = ~14 LT
	ASSESS development on NPOL radar and other real-time observations; assemble nowcasts	
	➔ low and hi a/c profile ADJUSTMENTS	~17-19 UT
	(Aircraft ARRIVE at delay point)	
3	**RECOMMEND profile changes to pilots**	~19 UT = 15 LT
	Pilots REQUEST profile changes from ATC	

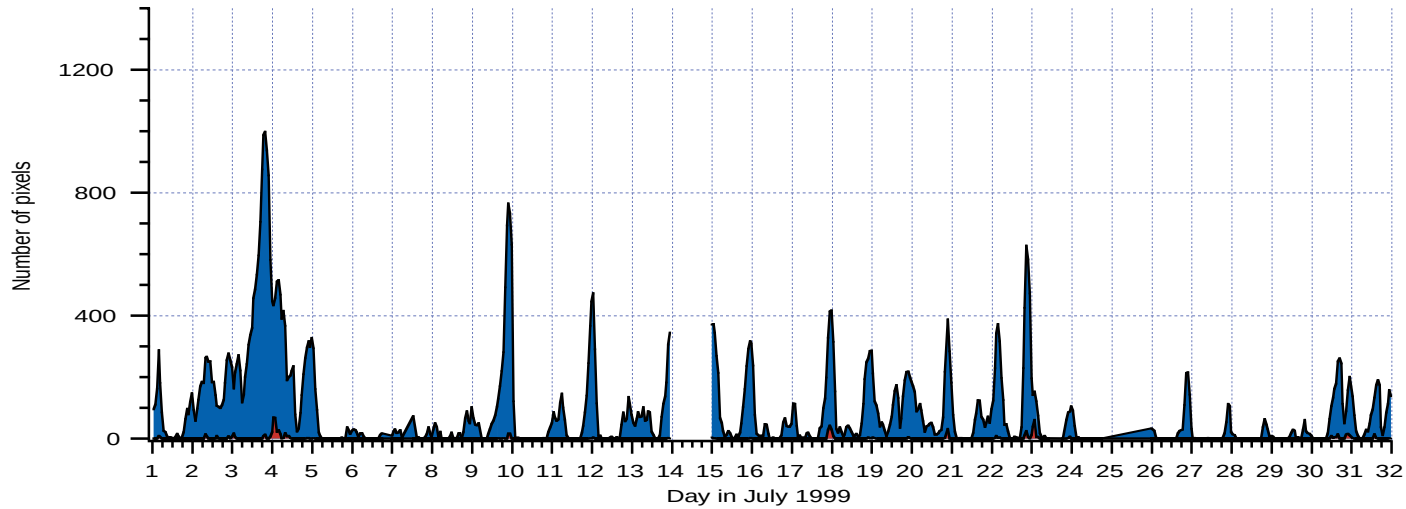
Predictable elements of the South Florida convective environment

- Dominance of the diurnal sea-breeze forcing
- (Relatively) weak synoptic scale and temporal variability in summertime easterly regime
- Well-documented weather regimes: *e.g Blanchard and Lopez*
- Lots of moisture, but uniformly distributed
- Synoptic-scale forcing relatively weak: low wind shear, weak T gradients

Diurnal variability of cold cloud area over South Florida

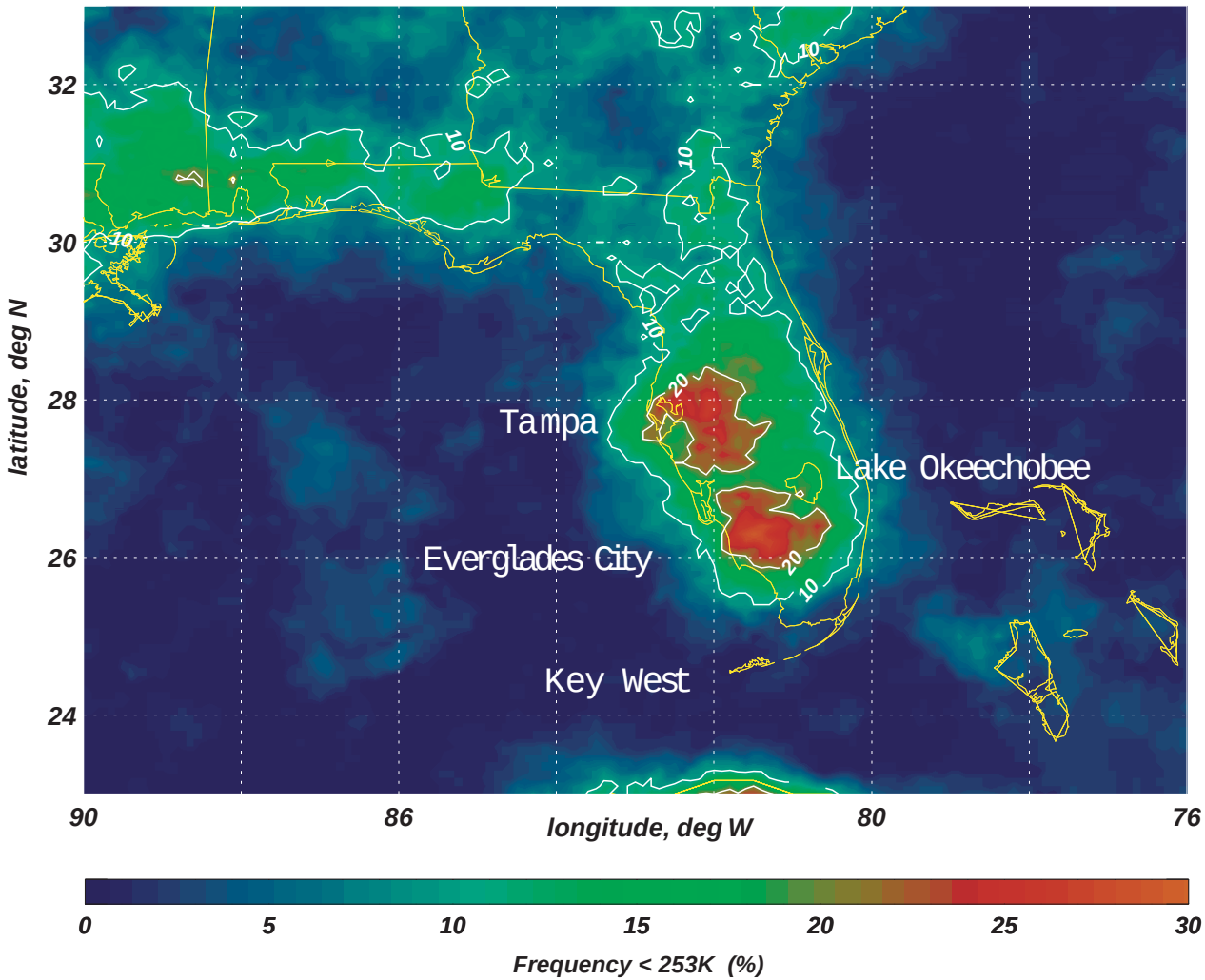


July '97



July '99

3-year frequency of cold T_{bb} at diurnal peak (6-7 PM LDT)



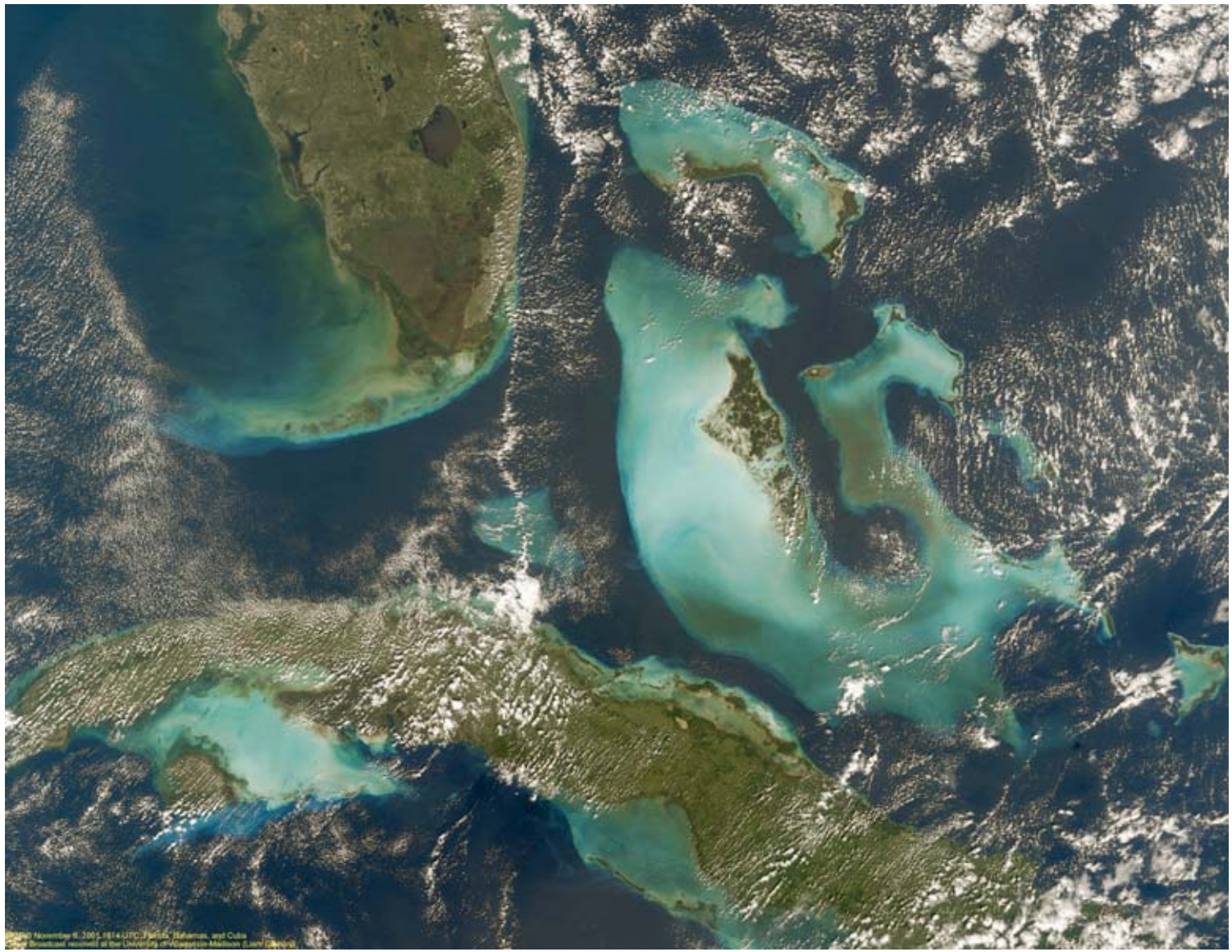
Weather support team tasks: diurnal anvil flights

1. **Provide next day's outlook for choice of flight profile suite: Type of convective regime** – day before
2. **Brief flight planners for timing and location of afternoon development to select takeoff time and first (delay) point** – morning of flight
3. **Arrange consultations with Navy forecaster** – morning of flight
4. **Contact NWS for guidance** – **Miami WFO:** morning of flight, **Key West WFO:** during flight

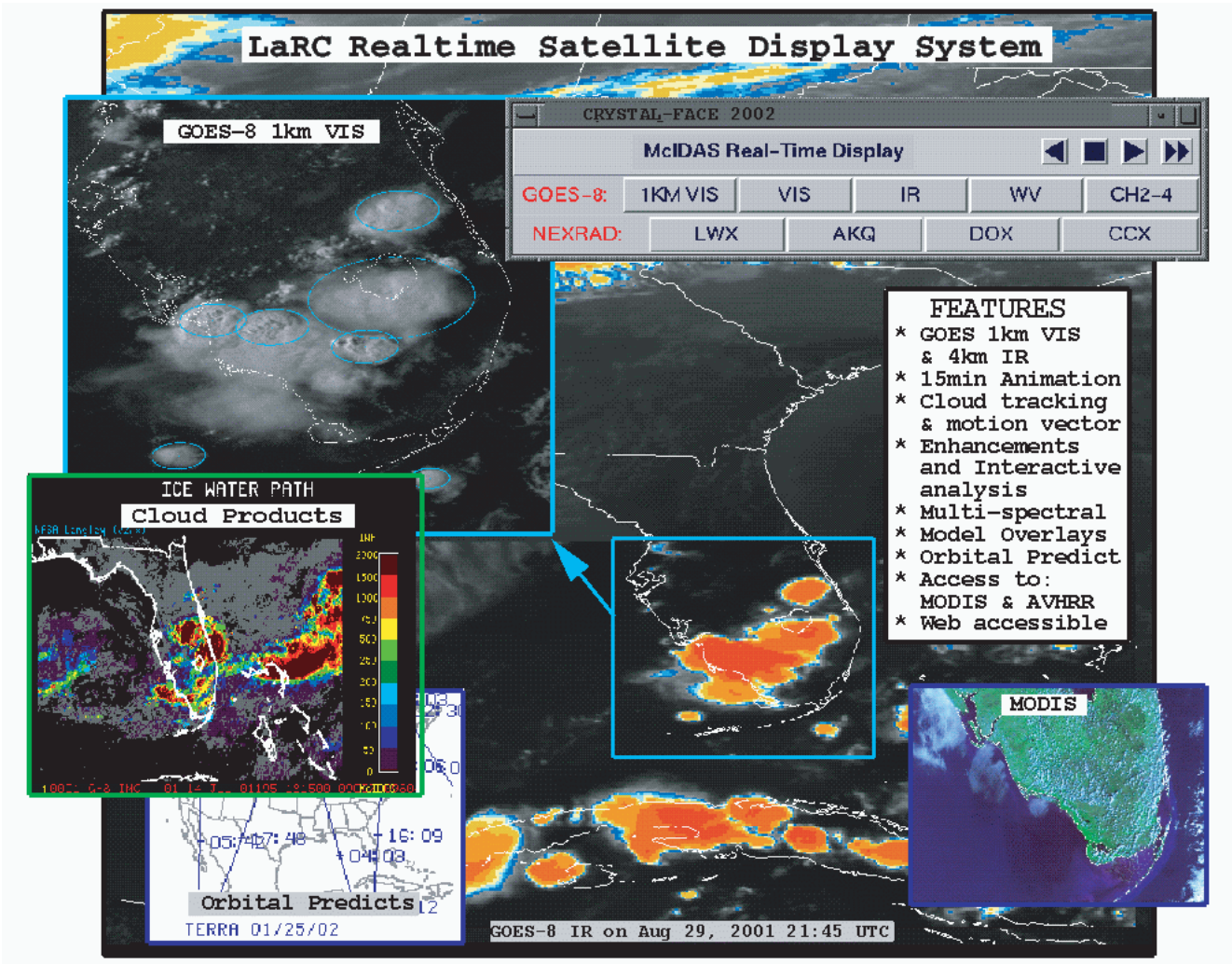
Satellite imagery, met products and planning tools

Group	Personnel	Tools	Sources	Products
U. Wisconsin /SSEC	S. Ackerman P. Antonellia	**McIDAS** **Java tool** **Web page**	**GOES** **MODIS** **AVHRR** **et al.**	•Near-real time satellite imagery, radiances, and derived cloud properties (1 hr) •Satellite winds in near real time from GOES •MODIS radiances (2 hours of overpass) •Ground site location MODIS radiances (on the fly)
NASA LaRC	P. Minnis B. Smith, Jr D. Young L. Nguyen D. Wang	**McIDAS analysis& flight planning** **Web page**	**GOES-8** **MODIS** **CERES** **AVHRR**	•McIDAS GOES near-real-time displays with derived products •plus soundings, weather data analysis •Web access to animations, MODIS, AVHRR, etc.
NASA ARC	R. Selkirk L. Pfister S. Gaines	**Ames ground station**	**GOES-8**	•Real-time Florida peninsula-scale pix and animation for all 5 channels at full resolution •Near-real time cloud height derivation
NASA GSFC	P. Newman L. Lait S. Pawson	**Goddard flight planner**	**MRF, GEOS-3 grids** **Soundings**	•Global forecast grids up to 5 days •Ingest wide variety of ancillary data •Flight planner with GUI
Aeronomy Lab	Adrian Tuck K. Rosenlof S. Hovde E. Ray	**Met widget flight planner**	**NCEP AVN grids, soundings** **Sat pix**	•Global forecast grids up to 5 days •GUI flight planner

U. Wisconsin/SSEC MODIS direct readout



Langley Satellite Display system

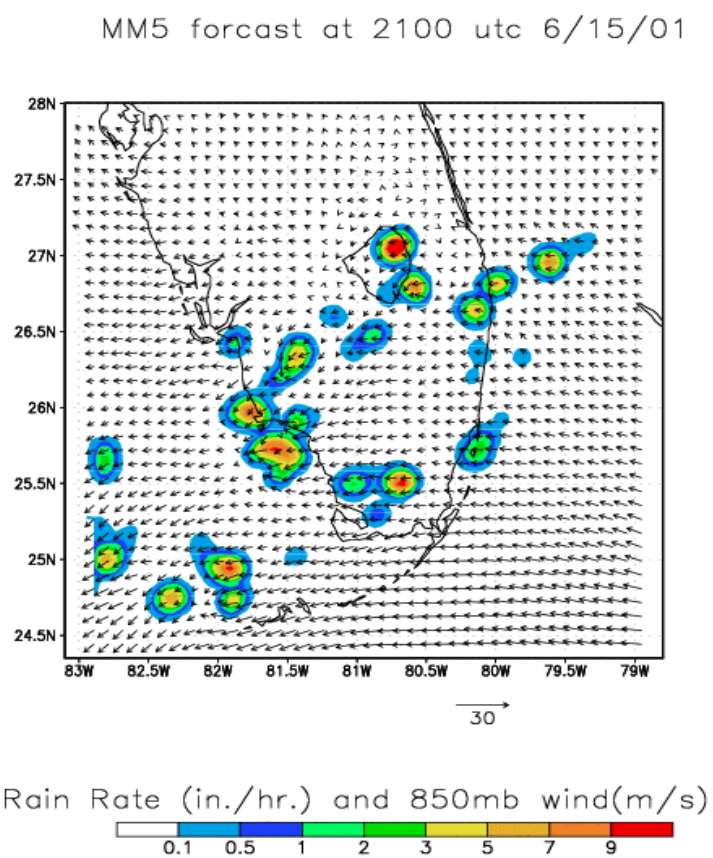


from Pat Minnis, et al.

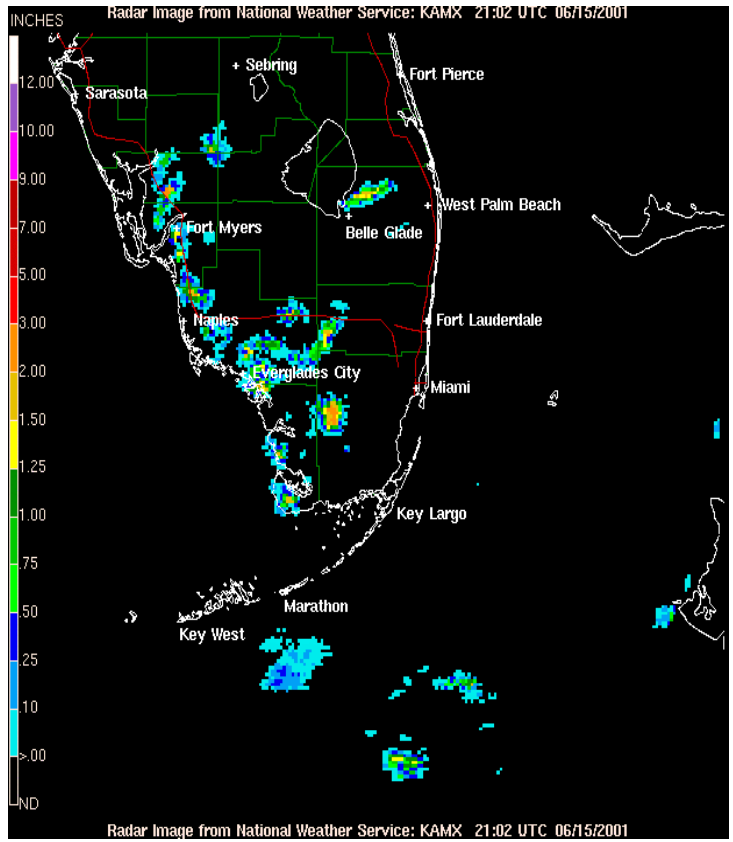
Mesoscale forecasting

Group	Personnel	Model	Model program/products
NASA GSFC/ Maryland	Y. Wang D. Starr	MM5 Kain-Fritsch 15-km; PLACE land sfc.; bulk microphysics; inner CR grid (5-km)	•Daily 36-hour fcsts initialized with ETA 32-km @ 00UT •Hourly u,v,w,T,q, IWC at 850,400,300 and 200 mb grids •Selected cross-sections * Girds can be delivered Goddard flight planner and other display systems
Maryland/ Rutgers/ GSFC	K. Pickering G. Stenchikov Y. Wang	Online MM5 tracer forecast	CO, radon-222, methyl iodide and ozone fields on pressure surfaces and X-sections
NASA Langley/ Hampton U.	D. Wang P. Minnis L. Nguyen	ReLAPS (ARPS) model	•Near real-time assimilation at 3-km scale w/ 3-D cloud fields •Mesoscale (15 km) fcsts to 48 hours •Cloud-scale (5 km) fcsts to 12-15 hours
Colorado State	W. Cotton R. Pielke	RAMS nested grid modeling	•Nested grid forecasts @ 3 km; 150 km x 150 km •ETA initialization •Produce “large-scale” forcings for convective-scale models, e.g. Penn State LES
Utah	S. Krueger M. Zulauf	NCEP global model	Model column output for evaluation of cloud-resolving models

GSFC MM5 forecast test case 6/15/01



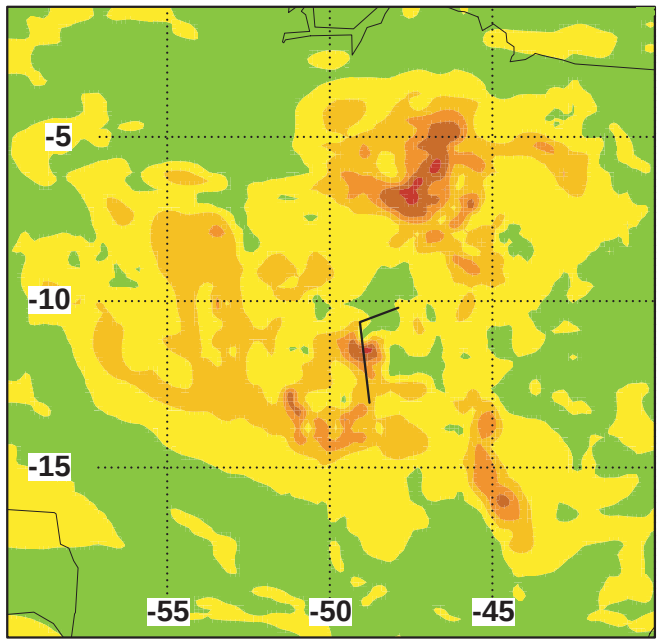
from Y. Wang, GSFC



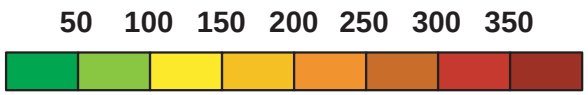
NWS radar

MM5 Simulation of System Sampled on GTE/TRACE-A

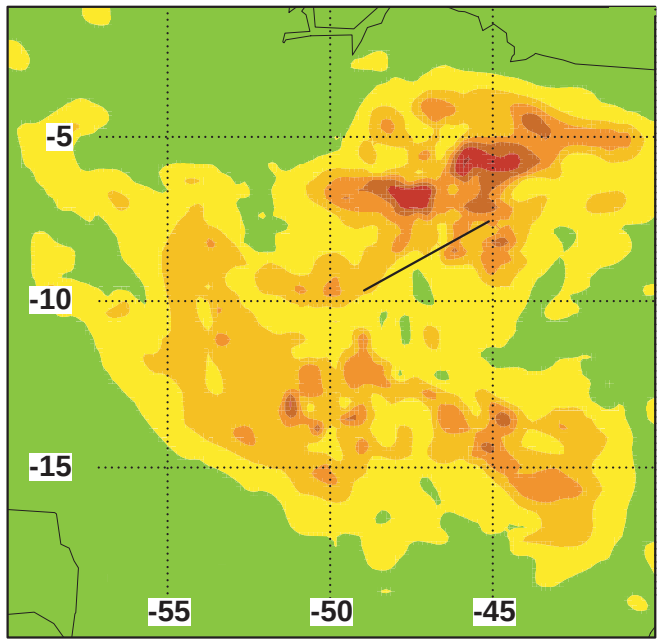
Positive definite scheme, grid+subgrid transport



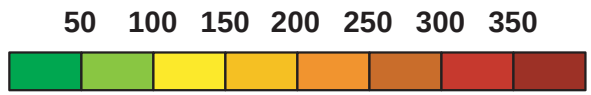
Average: 151 (obs.), 151 (model)
Initial: 101



CO mixing ratio(ppbv) at Z=9.5 km



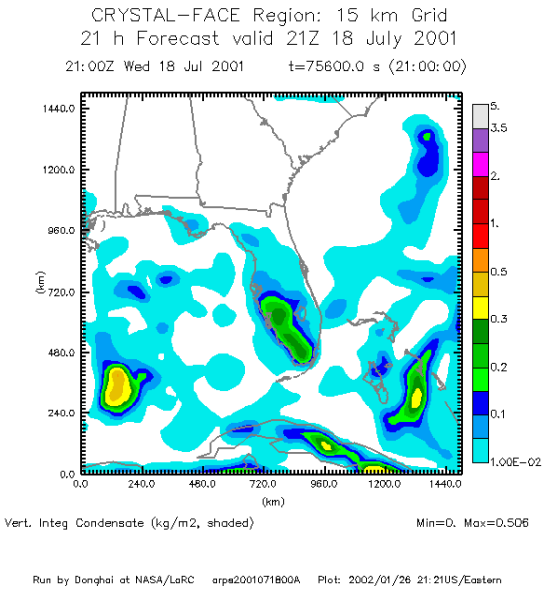
Average: 236 (obs.), 197 (model)
Initial: 93

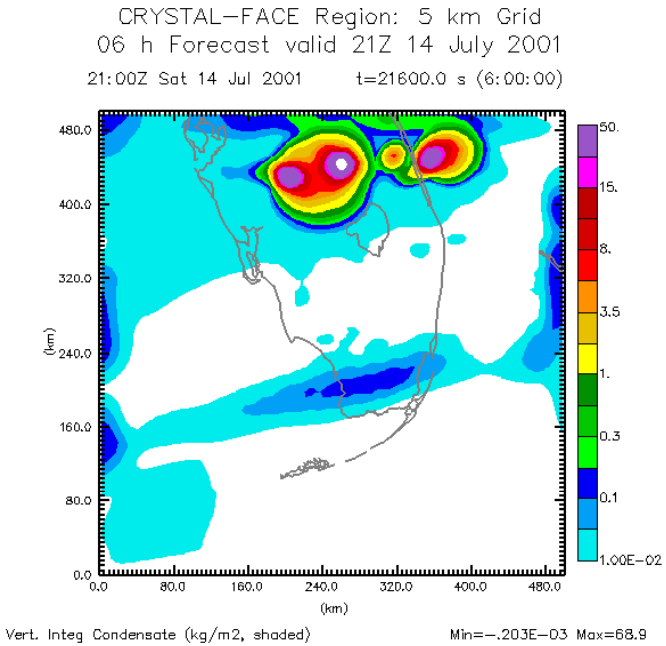


CO mixing ratio(ppbv) at Z=11 km

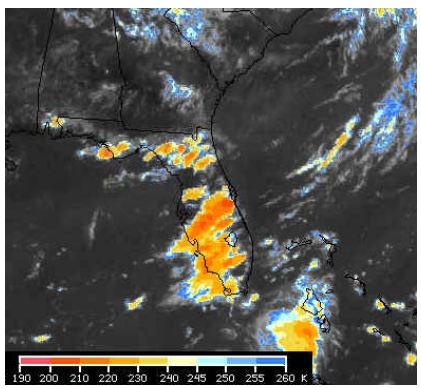
from K. Pickering, U. Maryland

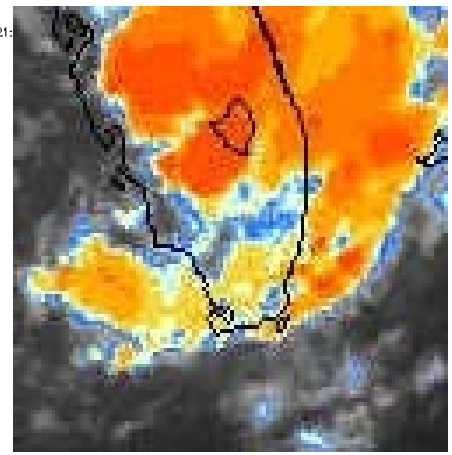
ReLAPS model vs. Satellite: July 2001





5-km

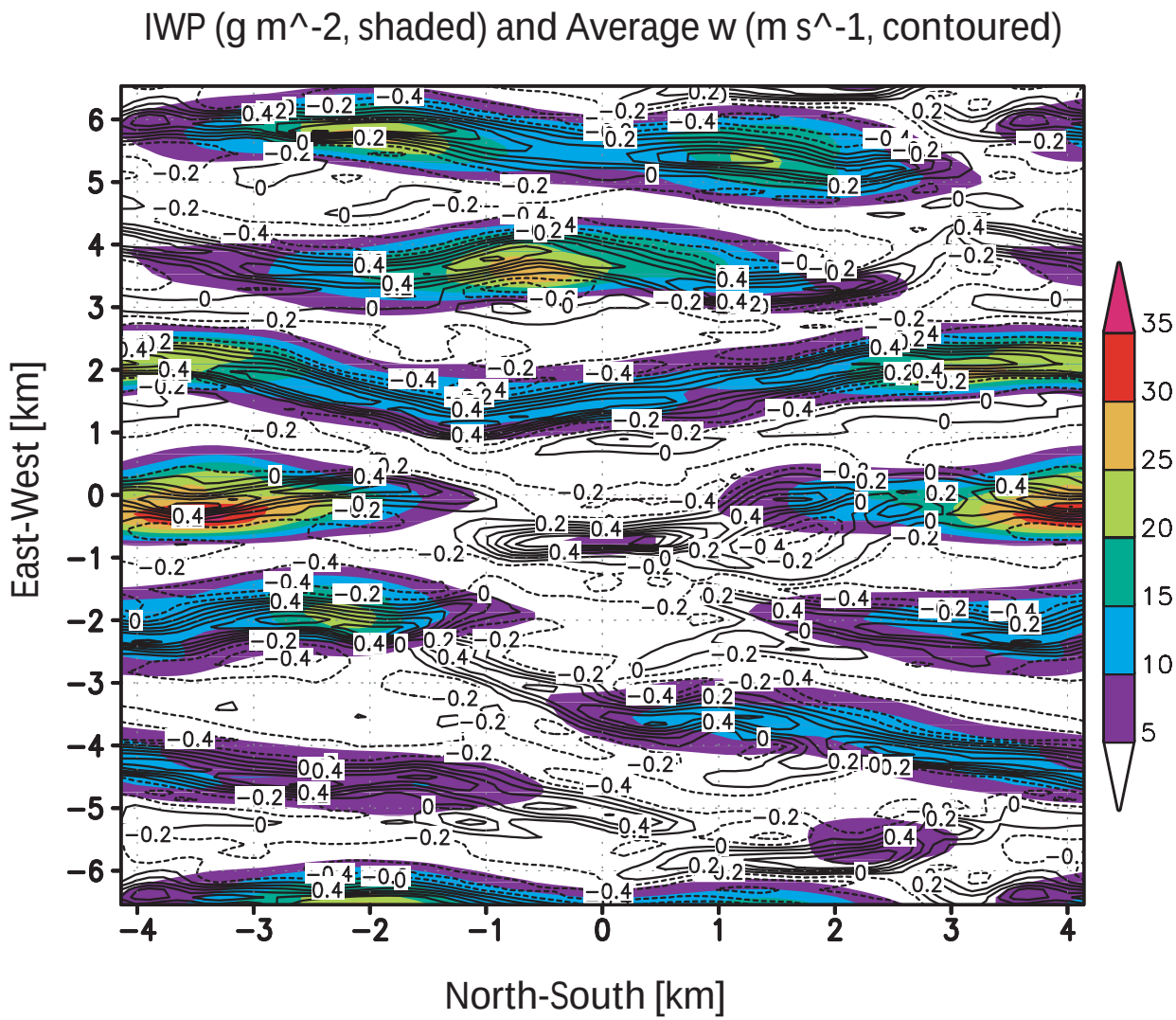




Microphysical and cloud model forecasting and guidance

Group	Personnel	Model	Model program/products
Penn State	J. Harrington	Stevens LES model Bulk microphysics	Cloud microphysics for interpretation of ELDORA data
Colorado	B. Toon J. Smith P. Colarco B. Gramblin M. Trebella	Subvisible cirrus interpretation Saharan dust modeling and guidance	•Aerosol burden guidance (with J. Prospero/U. Miami) and forecasts (with D. Westphal, NRL-Monterey) •Locations of subvisible cirrus from satellite obs
ARC/GSFC	H. Selkirk L. Pfister P. Newman	Ames/GSFC convective influence trajectory model	•Forecasts of convective influence over greater Florida region •Downstream dispersion of anvil air parcels

Penn State LES simulation of roll convection
(Ice Water Path)



Convective influence

WB-57F ACCENT mission, Gulf of Mexico, 23 April '99

6-day trajectories at 338 K
terminating in 5°x5° grid box
(over 20,000 trajectories)

Time since last convective encounter at 338 K

(WB-57F flight track in purple)

L. Pfister/R. Selkirk, ARC

Convective sources 60 hours upstream of flight path

(08 UT 21 April '99)

from L. Pfister/R. Selkirk, ARC

What needs to be done

- Continue investigations of south Florida weather predictability with historical weather and satellite data
  - *prediction of Blanchard & Lopez scenarios*
  - *distinguish large-scale characteristics of widespread, merged anvil days from isolated anvil days*
- Assemble forecast briefing teams from people going to Key West - *volunteers encouraged!*
- Forecasting and flight planning with historical data (July 2001?) exercise BEFORE mission
  - *tentatively mid-May at some central location*
  - *include flight planners, modelers, WX group and pilots*
- Continue interactions with Missions Group at FAA -
  - *develop DOABLE coordinated flight profile suites*